National Research Council Canada

2015–16

Report on Plans and Priorities

The Honourable James Moore
Minister of Industry

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Minister's Message

Canada will continue to benefit from responsible economic policies in 2015–16, including our low taxes, free trade opportunities and responsible investment regime.

The Industry Portfolio will help sustain job creation and economic growth by effectively managing programs and services that help Canadian companies compete and innovate. Canadians can depend on our government to invest in programs that benefit them the most. In 2015–16, the Industry Portfolio will continue to invest in world-class research and innovation that help companies compete at home and abroad.

Through its implementation of *Seizing Canada's Moment: Moving Forward in Science, Technology and Innovation 2014, the Portfolio is* encouraging collaborative partnerships between educational institutions and industry leaders that support research and commercialization.

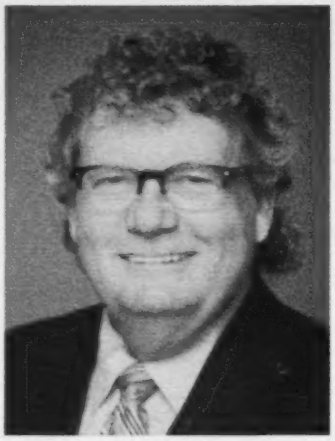
In 2015–16, the National Research Council of Canada will focus on the full implementation of its programs and service offerings, concentrating on delivering the support and expertise that Canada's innovative companies need. Innovation leads to job creation and economic growth, allowing companies to expand their domestic and international footprints.

The Industry Portfolio will help deliver on our government's commitment to return to a balanced budget by managing programs and services effectively. I am confident that we will meet our objective and that the National Research Council of Canada will continue to contribute toward economic growth and prosperity that benefit all Canadians.

James Moore

Minister of Industry

Minister of State's Message



As Minister of State for Science and Technology, I am pleased to present the *2015–16 Report on Plans and Priorities for the National Research Council of Canada*.

Our government has been integral in supporting basic and applied research, talent development, research infrastructure and innovation-related activities in the private sector with $11 billion in new federal funding since 2006.

I'm proud to say that as a result of this strong commitment, Canada tops the G7 in higher education research and development investments at our universities, colleges and research institutes. In recognition of the critical economic and social impact science has on Canadians, the government unveiled an updated strategy, *Seizing Canada's Moment: Moving Forward in Science, Technology and Innovation 2014*. The strategy is a vision and a road map for strengthening Canada's position as a global leader in scientific research while looking to harness greater Canadian innovations that create jobs, increase prosperity and improve the quality of life of Canadians.

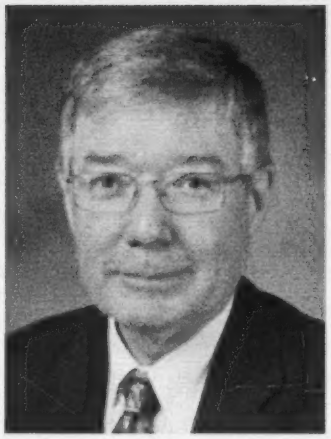
Over the coming fiscal year, our government will be looking to the National Research Council of Canada (NRC) to continue playing a critical role in supporting Canada's business innovation. NRC is ideally positioned to provide innovative Canadian-based businesses with the world-class infrastructure, technical expertise and people they need to develop their creative ideas and take them to the next level.

Moving forward, Canada will work hard to develop and attract high-quality researchers, both at home and abroad, to enrich our scientific enterprise and create greater prosperity for Canadians. Furthermore, we will continue to encourage collaborative partnerships and to enhance programs that support commercialization and knowledge transfer between higher education institutions and industry.

With a new strategy in place and a government firmly committed to innovation, our country is poised for another outstanding year. In 2015–16, we will work with all of our stakeholders to meet the objectives outlined in this report.

Ed Holder
Minister of State (Science and Technology)

President's Message



I am pleased to submit for tabling in Parliament, the 2015-16 Report on Plans and Priorities for the National Research Council (NRC). As we enter our third year as Canada's National Research and Technology Organization (RTO), we will concentrate on demand-driven research and development (R&D) initiatives to provide industry with a lower-risk way to develop innovative technologies, reduce start-up costs, and shorten time to market.

The updated federal Science, Technology and Innovation Strategy confirms the Government's commitment to business innovation and recognition of NRC as a key element in connecting Canadian firms with federal research and support.

In 2015-16, we will focus on continuing to deliver demonstrable results from our R&D initiatives for industry and Canada. Regular disciplined performance monitoring and three-year reviews will keep us on track to deliver. Building on NRC's Industrial Research Assistance Program Concierge Service, we will continue to refine our services, making it easier for firms and researchers to navigate and access federal business-facing programs, resources and networks. We will also continue to strengthen and grow our strategic international alliances and international networks, such as EUREKA, to facilitate Canadian access to foreign markets and global value chains.

In addition to meeting the immediate needs of industry, we are taking a look at the longer term emerging technologies that will underpin the future of the Canadian economy, such as the new Arctic initiative announced by the Prime Minister.

In the global competitive world of today, our imperative for an RTO is to protect the value generated for clients and Canada. During the coming year, NRC will embrace a secure and safety-oriented mindset and behaviour in our day-to-day business practices as part of strengthening our client-focused culture.

John McDougall
President, National Research Council of Canada

Section I: Organizational Expenditure Overview

Organizational Profile

Minister of Industry: The Honourable James Moore

Minister of State (Science & Technology): The Honourable Ed Holder

Institutional Head: John McDougall, President

Ministerial Portfolio: Industry

Enabling Instrument: [i†] *National Research Council Act*

Year of Incorporation / Commencement: 1916

Other: N/A

Organizational Context

Raison d'être

National Research Council of Canada (NRC) bridges the innovation gap between early stage research and development (R&D) and commercialization, focusing on socio-economic benefits for Canada and increasing national performance in business-led R&D and innovation. A federal leader in technology development, NRC supports Canadian industry to enhance their innovation capabilities and capacity and become more productive in the development and deployment of innovative products, processes and services for markets of national priority and importance. With a presence in every province, NRC combines its strong national foundation with international linkages to help Canada grow in productivity and remain globally competitive. NRC works in collaboration with industry, governments and academia to maximize Canada's overall R&D investment.

Responsibilities

NRC is a departmental corporation of the Government of Canada (GoC), reporting to Parliament through the Minister of Industry. NRC works in partnership with other members of the Industry Portfolio to leverage complementary resources to promote the innovation of firms, to exploit synergies in key areas of science and technology (S&T), to promote the growth of small and medium-sized enterprises (SMEs) and to contribute to Canadian economic growth. NRC's Council provides independent strategic direction and advice to the NRC President and reviews organizational performance. The President provides leadership and strategic management and is responsible for the achievement of NRC's long-range goals and plans within the guidance of the NRC Council. Each of NRC's seven Vice Presidents is responsible for a number of areas composed of research

programs, initiatives, centres, the Industrial Research Assistance Program, and/or corporate common services. Vice Presidents and NRC managers are responsible for executing plans and priorities to ensure successful achievement of objectives.

Mandate

Under the [i†] *National Research Council Act*, NRC is responsible for:

- Undertaking, assisting or promoting scientific and industrial research in fields of importance to Canada;
- Providing vital scientific and technological services to the research and industrial communities;
- Investigating standards and methods of measurement;
- Working on the standardization and certification of scientific and technical apparatus, instruments and materials used or usable by Canadian industry;
- Operating and administering any astronomical observatories established or maintained by the Government of Canada;
- Establishing, operating and maintaining a national science library; and
- Publishing and selling or otherwise distributing such scientific and technical information as the Council deems necessary.

NRC Vision

To be the most effective research and technology organization in the world, stimulating sustainable domestic prosperity.

NRC Mission

Working with clients and partners, we provide innovation support, strategic research, and scientific and technical services to develop and deploy solutions to meet Canada's current and future industrial and societal needs.

Strategic Outcome(s) and Program Alignment Architecture

1. Strategic Outcome: Canadian businesses prosper from innovative technologies
   - 1.1. Program: Technology Development and Advancement
     - 1.1.1. Sub-Program: Aerospace
     - 1.1.2. Sub-Program: Automotive and Surface Transportation
     - 1.1.3. Sub-Program: Ocean, Coastal and River Engineering
     - 1.1.4. Sub-Program: Energy, Mining and Environment
     - 1.1.5. Sub-Program: Construction
     - 1.1.6. Sub-Program: Aquatic and Crop Resource Development
     - 1.1.7. Sub-Program: Medical Devices
     - 1.1.8. Sub-Program: Human Health Therapeutics
     - 1.1.9. Sub-Program: Information and Communications Technologies
     - 1.1.10. Sub-Program: Security and Disruptive Technologies
   - 1.2. Program: Industrial Research Assistance Program (IRAP)
2. Strategic Outcome: R&D infrastructure for an innovative and knowledge-based economy
   - 2.1. Program: Science Infrastructure and Measurement
     - 2.1.1. Sub-Program: National Science Infrastructure
     - 2.1.2. Sub-Program: Measurement Science and Standards

Internal Services

Organizational Priorities

Priority 1	Type[1]	Strategic Outcome (SO)
Generate demonstrable results for clients through market-driven research, technology development, innovation support services and access to scientific infrastructure, helping Canada thrive in today's globally competitive, innovation-based economy.	Previously committed to	SO1: Canadian businesses prosper from innovative technologies, and SO2: R&D infrastructure for an innovative and knowledge-based economy
Description		
Why is this a priority? • This priority aligns with the Government of Canada's commitment to an efficient and competitive marketplace, a healthy and innovative knowledge-based economy, and a competitive and sustainable business community. As Canada's national Research and Technology Organization (RTO), NRC has the ability, experience, and national presence to actively engage with businesses in de-risking technologies, encouraging further investment and adoption by industry, thereby amplifying business innovation and national productivity.		

[1] Type is defined as follows: **previously committed to**—committed to in the first or second fiscal year prior to the subject year of the report; **ongoing**—committed to at least three fiscal years prior to the subject year of the report; and **new**—newly committed to in the reporting year of the RPP or DPR.

- As recognized by the 2014 federal Science, Technology and Innovation Strategy, there are a number of opportunities and challenges affecting Canada's ability to develop sustained economic growth. These include low business enterprise R&D expenditures (BERD), decreasing innovation and competitiveness (relative to established and emerging competitor nations), and lagging industrial productivity. Through the impacts and benefits generated by its R&D initiatives, NRC's efforts will help improve and strengthen these areas in tangible ways.
- To enhance Canada's capacity to generate new knowledge and translate it into real economic and social value, providing access to high quality scientific services and infrastructure is required. In collaboration with academic, industrial and government partners, R&D infrastructure must be managed effectively and efficiently to ensure it remains at the leading edge and is readily accessible, to promote and strengthen Canada's innovation ecosystem.

What are the plans for meeting this priority?

- Form and strengthen strategic partnerships, engage key stakeholders and facilitate networks among industry and innovation players – to lower technology development risk and solve short-term technological challenges.
- Advance emerging technologies of increasing importance nationally and globally, supported by foresight activities to remain ahead of the curve and anticipate the future needs of business.
- Support Canadian industry in accessing domestic and global markets by advancing the development of measurement standards that underlie domestic and international trade. Additionally, through its international framework, NRC will support Canadian industrial competitiveness by investing in key international networks (such as ["†] EUREKA) that facilitate access to global value chains.
- Through NRC-IRAP, provide SME clients with access to technical and business advice, networking opportunities, and cost-shared merit-based contributions for their innovative projects.
- Facilitate access to national, large-scale science infrastructure for Canadian research communities, including the TRIUMF sub-atomic research facility, and astronomical observatories, as mandated by the National Research Council Act.

Priority 2	Type	Strategic Outcome (SO)
Drive organizational growth to deliver on expected results and enable effective and efficient resource management for a sustainable and secure organization.	Previously committed to	SO1: Canadian businesses prosper from innovative technologies, and SO2: R&D infrastructure for an innovative and knowledge-based economy

Description

Why is this a priority?

- NRC must be agile, secure and sustainable in order to respond to Canadian industry needs and protect the value we create for them. NRC's business model requires strong centralized oversight of resources, investments and opportunities to ensure they are holistically managed with an eye to balancing risk. Resource management effectiveness will ensure that NRC R&D initiatives produce results, while maintaining low delivery costs.

What are the plans for meeting this priority?

- Increase external visibility of NRC R&D initiatives and opportunities, including international market/outreach strategies and relationship opportunities with Regional Development Agencies and provincial RTOs.
- Partner with other science-based departments to develop and pilot a single, shared online discovery and access platform for federal science library services and collections.
- Establish a security framework, operations and mindset that ensure the security of infrastructure, information and people, as a top priority for NRC.
- Continue regular corporate and R&D performance reporting to track delivery against objectives and make timely course corrections.
- Use three-year reviews of R&D performance to support management and investment decisions on continuance, adjustments or termination.
- Continue to implement succession planning, workforce planning and talent acquisition initiatives to ensure an agile and sustainable workforce to support the implementation of NRC's strategy.

Risk Analysis

Key Risks

Risk[1]	Risk Response Strategy	Link to Program Alignment Architecture
Delivery of Results for Clients & Canada: There is a risk that NRC is unable to effectively deliver expected results for clients and Canada, and demonstrate them in a manner that will sustain the confidence and support of the Government of Canada and other stakeholders.	**Key actions to respond to risk include:** 1. Use three-year reviews to evaluate performance, outcomes and impacts, and guide decisions on future activities. 2. Reinforce active use of communities of practice and advisory boards to work through challenges and collaborate 3. Implement disciplined management of resources, including active use of client relationship management system to have an accurate picture of opportunity pipeline 4. Implement quarterly reporting to track delivery against objectives, making timely corrections. 5. Implement General Manager-led project management standards **Indicators:** • Performance data • Three-year review findings • Client/stakeholder feedback	SO1: Canadian businesses prosper from innovative technologies and SO2: R&D infrastructure for an innovative and knowledge-based economy

Effective Implementation of Secure NRC: There is a risk that NRC will be unable to sufficiently shift organizational culture and employee behaviours to effectively implement the necessary governance, controls and practices for management of proprietary and confidential information subsequent to the cyber intrusion, affecting its perceived value and relationship with clients and partners.	**Key actions to respond to risk include:** 1. Continue Risk Assessment Committee to determine risks and approach/ mitigation 2. Complete Secure NRC Framework Project, including security capacity and roadmap, employee engagement and training 3. Define security roles and responsibilities between Shared Services Canada and NRC, and establish resolution mechanisms **Indicators:** • Client/stakeholder feedback • Employee participation in security activities and training • Reported security incidents and trends (IT and physical intrusions)	
Global Disruption: There is a risk that NRC is unable to respond in a timely manner to the potential impact of global event(s) which may lead to significant instability and economic downturn with impacts on client ability and/or willingness to invest in R&D.	**Key actions to respond to risk include:** 1. Define and implement a strategic intelligence initiative focussed on scenarios of potential major global disruptions, working with NRC Advisory Boards and Council 2. Identify key assets to protect in the event of the various scenarios that might materialize, and appropriate responses to be implemented **Indicators:** • Feedback from NRC (clients, stakeholders, partners) • Insights from NRC S&T network (Advisory Boards, NRC Council) and scanning of economic and geopolitical environment	

[1] The risks identified in the table are based on externally-focused risks in NRC's Corporate Risk Profile.

As NRC continues to make progress to recover from the cyber intrusion in summer 2014, a key priority for 2015-16 will be to continue working with federal partners to successfully implement a secure environment in a timely fashion, and regain momentum to deliver on its R&D initiatives and their resulting impacts for clients and stakeholders.

Increasingly unpredictable and pervasive global disruptions were also identified as a key risk issue, and stemming from that, a recognized need for NRC to be better prepared in order to respond effectively and efficiently to minimize the impact of (or optimize opportunities from) such events. Strategic foresight and intelligence, and scenario analysis and planning are priority undertakings to address these risks.

The actions identified above are intended to enhance NRC's existing controls and preparedness (e.g., around performance monitoring, opportunity management, and decision-making), balanced with considerations for operational efficiency and client responsiveness. A key to success will be NRC's continued focus on building leadership and management capacity to effect culture change, enhancing collaboration (internal and external), and strengthening communications.

Looking ahead for 2015-16, other internal factors influencing NRC's risks and opportunities to be managed include: transitioning to a secured operating environment; effectively and efficiently managing resources within a matrix environment; strengthening business capabilities in areas of importance such as financial forecasting, reporting and project management; building longer term capabilities of relevance to clients and stakeholders; and continuing implementation of NRC's Strategic Emergency Management Plan.

Key external factors affecting NRC's risks and opportunities include: awareness and visibility of NRC with potential clients/partners/stakeholders nationally and internationally; enhanced coordination of national innovation system players with the release of the federal government's updated Science, Technology and Innovation Strategy; declining business R&D investments in Canada, shifting the balance of global R&D investments; and growing international engagement of both NRC and Canadian firms through initiatives such as EUREKA.

Planned Expenditures

Budgetary Financial Resources (dollars)

2015–16 Main Estimates	2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
853,254,782	864,870,317[1]	856,758,506[2]	877,621,774[2]

[1] Planned spending for 2015-16 reflect changes announced in Budget 2014, including contributions to Youth Employment Strategy ($15 million) and to Canada Accelerator and Incubator Program (an additional $40.5 million over 4 years).

[2] Planned spending does not reflect future budget decisions.

Human Resources (Full-Time Equivalents [FTEs])

2015–16	2016–17	2017–18
3,314[1]	3,374[1]	3,428[1]

[1] Planned figures do not reflect future budget decisions.

Budgetary Planning Summary for Strategic Outcome(s) and Program(s) (dollars)

Strategic Outcome(s), Program(s) and Internal Services	2012–13 Expenditures	2013–14 Expenditures	2014–15 Forecast Spending	2015–16 Main Estimates	2015–16 Planned Spending[1]	2016–17 Planned Spending[1]	2017–18 Planned Spending[1]
Strategic Outcome 1: Canadian businesses prosper from innovative technologies							
Program 1.1: Technology Development and Advancement	261,874,311	317,721,198	329,477,982	278,902,744	289,693,954	308,400,163	327,782,818
Program 1.2: Industrial Research Assistance Program (IRAP)	244,628,683	278,130,653	287,791,456	293,359,644	293,359,644	265,841,644	265,841,644
Subtotal	**506,502,994**	**595,851,851**	**617,269,438**	**572,262,388**	**583,053,598**	**574,241,807**	**593,624,462**
Strategic Outcome 2: R&D infrastructure for an innovative and knowledge-based economy							
Program 2.1: Science Infrastructure and Measurement	94,893,647	99,678,744	108,791,006	77,443,974	78,268,299	79,860,370	81,340,983
Subtotal	**94,893,647**	**99,678,744**	**108,791,006**	**77,443,974**	**78,268,299**	**79,860,370**	**81,340,983**
Internal Services Subtotal	**203,408,271**	**198,887,611**	**265,485,563**	**203,548,420**	**203,548,420**	**202,656,329**	**202,656,329**
Total	**804,804,912**	**894,418,206**	**991,546,007**	**853,254,782**	**864,870,317**	**856,758,506**	**877,621,774**

[1] Planned spending does not reflect future budget decisions.

NRC's expenditure profile has increased since 2012-13 primarily as a result of investments and initiatives announced in Economic Action Plan 2012, Economic Action Plan 2013 and Economic Action Plan 2014. NRC's future expenditures profile does not reflect future budget decisions.

Alignment of Spending With the Whole-of-Government Framework

Alignment of 2015–16 Planned Spending With the [[iii]†] Whole-of-Government Framework (dollars)

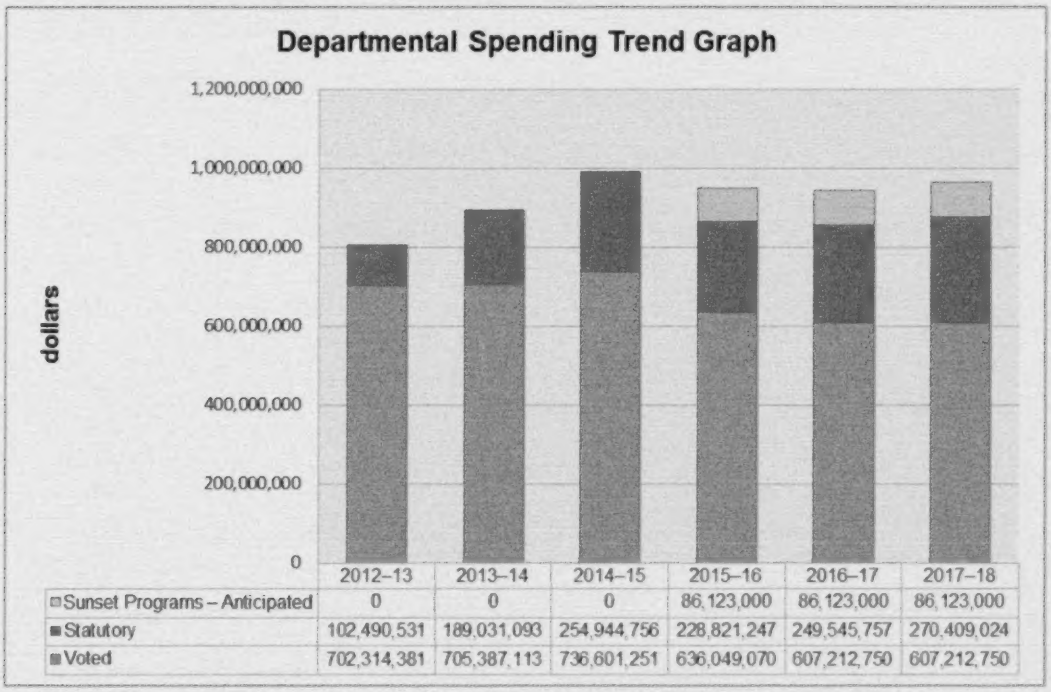
Strategic Outcome	Program	Spending Area	Government of Canada Outcome	2015–16 Planned Spending
SO1: Canadian businesses prosper from innovative technologies	1.1 Technology Development and Advancement	Economic Affairs	Strong Economic Growth	289,693,954
	1.2 Industrial Research Assistance Program (IRAP)			293,359,644
SO2: R&D infrastructure for an innovative and knowledge-based economy	2.1 Science Infrastructure and Measurement		Innovative and Knowledge-based Economy	78,268,299

Total Spending by Spending Area (dollars)

Spending Area	Total Planned Spending
Economic affairs	661,321,897[1]
Social affairs	N/A
International affairs	N/A
Government affairs	N/A

[1] Planned spending excludes the cost of Internal Services.

Departmental Spending Trend



	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18
Sunset Programs – Anticipated	0	0	0	86,123,000	86,123,000	86,123,000
Statutory	102,490,531	189,031,093	254,944,756	228,821,247	249,545,757	270,409,024
Voted	702,314,381	705,387,113	736,601,251	636,049,070	607,212,750	607,212,750

Planned spending for future years does not reflect future budget decisions. Anticipated Sunset Programs include contribution to TRIUMF (Canada's National Laboratory for Particle and Nuclear Physics) and NRC's strategic focus to help the growth of innovative businesses of Canada.

Estimates by Vote

For information on NRC's organizational appropriations, consult the [[iv]†] *2015–16 Main Estimates* on the Treasury Board of Canada Secretariat website.

Section II: Analysis of Program(s) by Strategic Outcome

Strategic Outcome 1: Canadian businesses prosper from innovative technologies

Program 1.1: Technology Development and Advancement

Description

This program develops and advances technologies to enhance the prosperity of Canadian industries in support of federal priorities such as the federal Science, Technology and Innovation Strategy. This includes national-scale flagship technology-development initiatives having sufficient critical mass to contribute demonstrably to national prosperity. To bring new and innovative products and processes to the marketplace, companies must advance the emerging and maturing technologies embodied in applied developments and prototypes to a level where the risk is sufficiently reduced to be acceptable from business, investment, and regulatory perspectives. The program bridges this critical technology gap through mission-oriented research and development services, and specialized technical services such as custom design and fabrication, testing, prototyping, up-scaling, and demonstration in specialized facilities.

Budgetary Financial Resources (dollars)

2015–16 Main Estimates	2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
278,902,744	289,693,954	308,400,163	327,782,818

Human Resources (Full-Time Equivalents [FTEs])

2015–16	2016–17	2017–18
1,681	1,723	1,773

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Canadian industries commercialize advanced technologies	Technology deployment (client commitments to exploit NRC innovations)	19	March 2016
	Client/stakeholder feedback on benefits: jobs, sales, R&D	82%[1]	March 2016

[1] The proportion of surveyed clients and stakeholders who report an increase in jobs, sales, R&D expenditures or other positive benefits as result of services received from NRC.

Planning Highlights

This program will deliver targeted research, technology development and demonstration, and direct technology support to Canadian industry – elements that are crucial for Canadian companies to thrive in a highly competitive global market. In 2015-16, research initiatives started in the previous fiscal year under this program will be in full implementation mode and several of them will deliver either early, short-term outcomes and/or crucial milestones important for outcomes planned to be achieved over a mid-term time horizon.

Based on initial experiences with NRC's new program-based structure, best practices of program and project management will be shared between R&D leads and project managers in order to ensure that NRC's R&D initiatives will be successful and that the organization will bring significant value to Canadians in an efficient and effective way.

While NRC's IT infrastructure was compromised in 2014, the organization has continued to grow collaborations, fully implement the program model and position itself well in contributing to the innovation system. As the organization implements a secure operating model, potential delays may occur that would affect expected results of plans and priorities for 2015-16.

Sub-Program 1.1.1: Aerospace

Description

This sub-program advances product and process technologies to enhance the prosperity of the aerospace industry sector in Canada that is striving to remain competitive in the face of razor-thin margins and increasing regulatory demands. The sector is important to the Canadian economy as a major contributor to manufacturing trade and for hundreds of thousands of skilled jobs at all levels of the supply chain. It is also important for its impacts on the transportation costs of materials and products that drive the economy. Results are achieved through multi-disciplinary collaborative research and development services in addition to specialized technical services in specialized facilities, such as testing and prototyping, for transferring or advancing technologies into deployed solutions and improved practices for the marketplace.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
51,777,378	55,474,817	60,716,062

Human Resources (FTEs)

2015–16	2016–17	2017–18
296	310	324

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancements of aerospace process and product technologies	Client/stakeholder financial investment in technology development	$36.5M	March 2016
	Licensing and royalty revenue from NRC clients	$0.05M	March 2016

Planning Highlights

NRC strives to enhance the competiveness of Canada's aerospace sector. Innovation is seen in the form of fresh ideas, new technologies and development, and demonstration of products and processes specifically targeting the strategic and market challenges addressed by the following six R&D initiatives: Aeronautics for the 21st Century; Air Defence Systems; Aeronautical Product Development Technologies; Reducing Aviation Icing Risk; Civilian Unmanned Aircraft Systems; and Working and Travelling on Aircraft.

In 2015-16, efforts will focus on advancing high temperature materials and characterization technologies, in order to develop ceramics matrix composites. They will further evaluate these materials for engine applications.

Another key focus will be to develop, demonstrate and mature new and retrofit technologies, with the ultimate goal of transferring these technologies to Canadian industry for commercialization across the supply chain. In 2015-16, activities will include:

- Development of a Twin Otter 400 Level-D Simulator Model. NRC will design, fabricate and install an instrumentation system on-board the aircraft and complete flight tests of the land plane and seaplane variants.
- Working with Transport Canada to develop the Seaplane Qualification Test Guide for Simulators.
- Further development of supercool large droplets and ice crystal capabilities for transport category airplanes certified for flight in icing conditions (to meet updated standards).

In order to increase Canadian content in existing and future aircraft platforms, NRC puts a special emphasis on engaging and strengthening Canada's lower-tier suppliers through multi-party collaborations for the deployment of technologies at all levels of the supply chain. It is expected that in the long term, when several new technologies and processes will be in place, they can contribute to reducing emissions of aircraft and help to reduce the cost of operations.

Sub-Program 1.1.2: Automotive and Surface Transportation

Description

This sub-program provides technical knowledge and advances product and process technologies for producing more fuel-efficient, affordable, and environmentally-responsible ground vehicles and for delivering engineering solutions to complex technology challenges facing surface transport industries including heavy vehicle and rail. This is important for reducing transportation infrastructure and costs and for enhancing Canada's share of ground vehicle supply chains and for enhancing the prosperity of the ground vehicle industry sector in Canada as it is faced with growing environmental concerns, competitive pressures, and stringent regulations. The Canadian economy relies on advanced manufacturing sectors such as the ground vehicle industries as major economic drivers, accounting for a significant portion of manufacturing trade, and therefore must remain competitive. Results are achieved through multi-disciplinary collaborative research and development services in addition to specialized technical services, such as testing, prototyping and system integration, for transferring or advancing technologies into deployed solutions and improved practices for the marketplace.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
38,254,232	41,281,237	45,013,855

Human Resources (FTEs)

2015–16	2016–17	2017–18
214	224	233

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancements in ground vehicle process and product technologies	Client/stakeholder financial investment in technology development	$25.8M	March 2016
	Licensing and royalty revenue from NRC clients	$0.50M	March 2016

Planning Highlights

NRC focuses on improving competitiveness and safety, as well as energy efficiency, through technology development focused on key industry priorities in the following six R&D initiatives: Advanced Manufacturing and Design Systems; Industrial Biomaterials Flagship; Fleet Forward 2020: Advancing Vehicle Fleet Performance; Lightweighting of

Ground Transportation Vehicles; Rail Vehicle and Track Optimization; and Vehicle Propulsion Technologies.

In 2015-16, research efforts will be applied on advancing transmission technologies in order to achieve a significant increase in vehicle fuel economy over the next few years. This will include validation and specifications for low friction coatings, which are part of the development of low friction, wear resistant, high strength materials for power trains. A new formulation of iron powder for use in transmission components will also be developed, in partnership with industry.

Further, in 2015-16, NRC will conduct a feasibility study on vehicle health monitoring. This study will be the precursor for developing and deploying sensors and data gathering systems for monitoring vehicle performance and predicting maintenance needs and ultimately avoiding vehicle failures, thus lowering the operational costs for companies using heavy duty ground vehicles.

Another important area for NRC is vehicle light-weighting through the development of aluminum and bio-composite parts and structures. In 2015-16, NRC will work with industry leaders to demonstrate new forming and assembly manufacturing processes to produce aluminium basic structures for automotive and bus chassis applications.

Sub-Program 1.1.3: Ocean, Coastal, and River Engineering

Description

This sub-program develops and advances technologies and standards for safe and effective operations in Canada's vast ocean, coastal and river environments, including the Arctic. This is important for lowering barriers for natural resource development and for enhancing the prosperity of the Canadian marine transportation and water resource sectors facing costly challenges of harsh environments (ice, wind, waves, currents), extreme weather events (floods, "100 year wave"), and coastal erosion. Results are achieved by working with Canadian industry through multi-disciplinary collaborative research and development services in addition to custom technical services, such as testing, prototyping, numerical modeling, and system integration in specialized facilities, for transferring or advancing technologies into deployed solutions and improved practices for the marketplace.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
14,201,471	15,209,241	16,920,595

Human Resources (FTEs)

2015–16	2016–17	2017–18
94	98	103

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancements of process and product technologies for ocean, coastal and inland water engineering	Client/stakeholder financial investment in technology development	$13.6M	March 2016
	Licensing and royalty revenue from NRC clients	Under development[1]	

[1] As R&D initiatives get underway and agreements are established, a licensing and royalty revenue target will be set when full complement of baseline data has been collected and analysed.

Planning Highlights

NRC works with clients and partners to reduce risks and costs of marine operations, while assuring safe and responsible development of marine-based resources in the following three R&D initiatives: Arctic; Marine Infrastructure, Energy and Water Resources; and Marine Vehicles.

In 2015-16, a key focus will be to establish baselines for a marine vessel performance monitoring and analysis system, with the goal of reducing fuel consumption. Further work will be done on developing advanced control systems / autopilots integrated with

roll stabilization. Once these systems are fully developed and commercialized, clients will be able to identify methods for the reduction of fuel consumption and, thus, lower operational costs.

NRC's new Arctic initiative, announced by the Prime Minister in August 2014, supports Canada's Northern Strategy and aims to improve the lives of Northerners and to advance Northern economic development. It is tailored towards four priority areas, namely resource development, northern transportation including shipping, marine safety, and community infrastructure. Activities in 2015-16 will focus on consolidating Northern participation in the program at the onset through dedicated site visits, community discussions, and project-level involvement. Early projects will look at crucial issues around ice forecasting, ice management and drifts in pack ice.

Another priority for 2015-16 will be to engage in developing and applying simulation tools to evaluate the performance of vessels; tools that Canadian ship designers can use during the vessel design phase, leading to a reduction of design costs of Canadian mid-size vessels. Preparatory work will also be undertaken in the area of inshore and ice class vessel design. This includes establishing baselines for various vessel design costs. Lower design costs will eventually strengthen the competitiveness of Canadian ship design companies in the global market.

Sub-Program 1.1.4: Energy, Mining and Environment

Description

This sub-program develops and advances technologies and techniques for enhancing the innovation capacity and growth of Canada's natural resources and utility sectors. These sectors are important contributors to Canada's GDP that are challenged by volatile global markets and growing environmental pressures. To remain sustainable, industries in these sectors require technologies to reduce production costs. Results are achieved through multi-disciplinary collaborative research and development services in addition to specialized advisory and technical services for transferring or advancing technologies into industrial solutions for the marketplace.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
22,048,883	23,223,224	24,549,295

Human Resources (FTEs)

2015–16	2016–17	2017–18
138	142	145

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancements of process and product technologies for the natural resources and utility sectors	Client/stakeholder financial investment in technology development	$8.0M	March 2016
	Licensing and royalty revenue from NRC clients	$0.3M	March 2016

Planning Highlights

NRC provides practical and imaginative solutions to complex technology challenges in the energy, mining and environment sectors, enhancing innovation through their value chains. The mentioned sectors consist of energy (fossil and renewable), metal (gold, copper and zinc) and non-metal (biomass, coal, uranium, diamonds and phosphate) resources along with associated environmental services sectors. This sub-program will play an essential role in supporting Canada's industry through the following research initiatives: Bioenergy; Energy Storage for Grid Security and Modernization; and High Efficiency Mining.

In 2015-16, a key priority in mining R&D will be to evaluate membrane separation technologies for more energy efficient process improvements. Research on mining equipment will evaluate the wear and corrosion mechanism for fine particles. This work

is required for the subsequent development of low-cost processing of low grade ores utilizing fine particles.

Another key focus in 2015-16 will be on energy storage and grid security. A series of technical studies will be initiated related to standards, codes, and gaps, as well as links between regulations to energy storage systems and the respective supply chain for a range of technologies including Lithium-ion batteries, flow batteries, lead acid batteries, inverters and controls. The insights generated by these studies will reduce the deployment risk of energy storage technologies and allow end users to integrate renewables more effectively into the power grid while optimizing the use of existing infrastructure.

Sub-Program 1.1.5: Construction

Description

This sub-program provides technical knowledge and it advances product and process technologies to enhance the prosperity of the Canadian construction industry sector as it faces critical challenges in responding to expectations for better performing and more affordable buildings and infrastructure while striving to remain competitive in the global marketplace. The success of this sector is critical as a major contributor to Canada's GDP, employing millions of individuals, and managing assets valued in the trillions of dollars. Results are achieved through multi-disciplinary collaborative research and development and standardization services in addition to custom technical services -- such as testing, product and process validation, prototyping, and system integration in field and in specialized facilities -- for transferring or advancing technologies into deployed solutions and improved practices for the marketplace.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
23,308,344	25,020,967	27,149,766

Human Resources (FTEs)

2015–16	2016–17	2017–18
156	153	159

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancements of process and product technologies for the construction industry sector	Client/stakeholder financial investment in technology development	$15.9M	March 2016
	Licensing and royalty revenue from NRC clients	$0.32M	March 2016

Planning Highlights

The Construction sub-program will be focused on providing a competitive advantage to all segments of the Canadian construction industry in the following three R&D initiatives: Critical Concrete Infrastructure; High Performance Buildings: Retrofit Technologies for Commercial and Institutional Buildings; and Canadian Wood in Mid-Rise Buildings. In addition to these three initiatives, the sub-program will maintain responsibility for expert review of model building regulations and for providing technical evaluation services that facilitate commercialization of innovative building products. This is accomplished within the Building Regulations and Market Access thrust.

A major area for NRC is the reduction of manufacturing costs of prefabricated housing assemblies with increased Canadian wood content, thereby strengthening the Canadian construction industry along the value chain for wood buildings and wood-based building products.

In 2015-16, NRC will support the development of new products enabling the Canadian mid-rise wood buildings value chain to grow and to establish itself in new markets. Stakeholders of this segment of the industry include manufacturers of wood-based construction products and building systems, as well as export companies and firms serving niche markets.

Following the development of technical solutions for 5-6 storey buildings, a focus in 2015-16 will be on developing hybrid Cross Laminated Timber /steel/concrete designs; developing of inspection and monitoring guidelines; and the cost and productivity assessment of pre-fabricated structural assemblies. By the end of 2015-16, the latter will be validated for fire, acoustic, and energy performance.

For site built wall and floor assemblies, NRC will validate previously developed on-site designs and assemblies, and on the assessment and improvement of fire-fighting techniques related to them.

Sub-Program 1.1.6: Aquatic and Crop Resource Development

Description

In collaboration with industry, this sub-program develops improved varieties of crops and develops technologies for maximizing crop value and converting biomass to enhance the prosperity and global market share of the Canadian agriculture, bio-product, and natural health product industry sectors. This includes development and validation of value-added goods – from natural ingredients and health products through to chemicals and industrial oils and other products – for leveraging Canada's abundant aquatic and crop resources. Results are achieved through multi-disciplinary collaborative research and development services in addition to specialized technical services for transferring or advancing technologies into deployed solutions and improved practices for the marketplace.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
25,248,626	26,813,780	27,391,050

Human Resources (FTEs)

2015–16	2016–17	2017–18
135	136	138

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancements in agricultural crops and related value-added products	Client/stakeholder financial investment in technology development	$5.0M	March 2016
	Licensing and royalty revenue from NRC clients	$0.30M	March 2016

Planning Highlights

NRC will provide bio-based specialty chemical industry collaborators with research expertise, technical services and infrastructure needed to overcome technology barriers to produce high-value, performance-driven chemicals from biomass which will enable them to reach commercial activity 15-20% faster. Industrial and consumer end markets including personal care and cosmetics, food and nutrition, household goods and agricultural products will be targeted.

In 2015-16, activity in Natural Health Products will be expanded by co-developing additional products with Canadian companies and deploying five industry-wide enabling technologies. Technical services and strategic research and development will be

undertaken to ensure Canadian natural health product companies maintain their global reputations for quality and safety.

Another priority initiative is the management of carbon dioxide emissions through algal carbon conversion. In 2015-16, NRC will continue to work with large industrial carbon dioxide emitters and SMEs to deploy algae cultivation systems, to identify, improve and deploy effective photobioreactor technologies; to identify optimal algae strains and technologies for their growth; and to optimize harvesting and de-watering solutions for the conversion of carbon dioxide to algal biomass from which bioproducts can be derived. This will help create markets for Canadian photobioreactor producers and other SMEs in the technology value chain, and help improve the environmental footprint of Canada's oil sands.

Finally, NRC will continue to contribute to the Canadian Wheat Alliance (CWA) between NRC, Agriculture and Agri-Food Canada, the University of Saskatchewan, the Province of Saskatchewan with support from the Genomics R&D Initiative (GRDI). The goal is to improve the profitability of wheat to help bolster the Canadian economy and improve the profitability of Canadian farmers. In 2014, Fusarium head blight significantly affected the quality of durum wheat, causing lower exports and revenues. NRC will continue research to reduce wheat losses due to Fusarium, rust diseases, heat, drought and cold. To help improve breeding efficiency by reducing the time to develop a new wheat variety by 2-4 years, the CWA will continue to collaborate with two leading wheat breeding companies (Syngenta and KWS) in the area of double haploid technology.

Sub-Program 1.1.7: Medical Devices

Description

This sub-program applies expertise in biochips, nano-materials, micro-devices, in vitro diagnostics, imaging, optical bio-photonics, medical simulation, and radio-frequency engineering and electronics to develop and advance technologies for enhancing the prosperity of the medical device industry as it strives to respond to increasing demands for equipment and supplies that are faster, more accurate, more informative, more affordable and less invasive. The industry is important for its growing contribution to Canada's GDP and its contribution to effective and efficient health care. Results are achieved through provision of industry-driven technical services and multi-disciplinary collaborative research.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
8,996,650	9,470,010	9,736,110

Human Resources (FTEs)

2015–16	2016–17	2017–18
51	51	52

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancements in medical devices for the marketplace	Client/stakeholder financial investment in technology development	$3.2M	March 2016
	Licensing and royalty revenue from NRC clients	$0.20M	March 2016

Planning Highlights

Health care cost, efficiency and effectiveness remain Canadian priorities and are driving the development of improved lower cost therapies, diagnostics and treatments, and creating domestic and global market opportunities for Canadian-based companies. Hospitals are demanding innovative technologies to increase patient safety, shorten recovery time, provide cost savings in the operating room and, consequently, improved patient care. In addition, the drive to reduce health care costs has created opportunities for innovative technologies delivered in cost-effective settings such as home care.

In 2015-16, NRC will work with Canadian-based companies in the medical device sector to develop compact, cost-effective technologies which provide rapid, sensitive, accurate and globally competitive low cost solutions. NRC will leverage core competencies in

biochips, radiofrequency engineering and electronics, functional nanomaterials, microdevices, *in vitro* diagnostics, medical photonics and medical simulation technologies to help these companies get leading edge innovations on the market.

Another focus in 2015-16 will be to enhance food and water safety for Canadians through rapid pathogen detection devices. In collaboration with other science-based federal departments and agencies, and with support from the GRDI, NRC will develop devices that will provide rapid detection, from sample to answer in less than six hours (compared to 24 hours or more for conventional technologies).

Finally, NRC will focus its international priorities in the medical devices domain on the innovation-intensive countries of Israel and Taiwan. Using the EUREKA collaboration framework, NRC will assist in creating collaborations between Israeli and Canadian medical device companies to allow for technology transfer. Similarly, NRC will work with the Taiwanese RTO, ITRI, in bringing together SMEs from both jurisdictions to focus on innovative medical device product development and manufacturing processes.

Sub-Program 1.1.8: Human Health Therapeutics

Description

In collaboration with industry, this sub-program develops vaccines and biologics for enhancing the prosperity of the Canadian bio-therapeutics industry, and to provide more effective treatments to Canadians. Activities include developing biologic materials for treating and preventing infectious and chronic diseases, and technologies to deliver therapeutics from circulation in the blood to the central nervous system. Results are achieved through multi-disciplinary collaborative research and development services in addition to specialized technical services for transferring or advancing technologies into deployed solutions and improved practices for the marketplace.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
37,586,916	39,753,086	41,800,403

Human Resources (FTEs)

2015–16	2016–17	2017–18
224	229	234

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Improved and more affordable vaccines and biologics for the marketplace	Client/stakeholder financial investment in technology development	$14.2M	March 2016
	Licensing and royalty revenue from NRC clients	$2.7M	March 2016

Planning Highlights

NRC supports early stage innovation in the development of biologics in areas of high medical need. Biologics are highly potent and their specificity lends itself to the development of a personalized medicine approach. Biologics are the fastest growing and most promising class of pharmaceuticals. In 2012, they represented 71% of global revenue generated by the top 10 selling drugs compared to only 7% in 2001. With its expertise and infrastructure in antibody generation, molecular modeling, cell culture optimization, in vitro and in vivo activity assays and bioprocessing, NRC is well positioned to co-develop biologics with Canadian industry.

Vaccines are one of the most useful and cost-effective tools for reducing morbidity and mortality associated with infectious diseases. In Canada, immunization has saved more

lives over the last 50 years than any other health intervention. NRC scientists have a track record in developing technologies for vaccines development.

A major impediment in treating diseases of the central nervous system (CNS) is the blood brain barrier (BBB) that prevents most drugs from reaching the brain. NRC is developing a suite of carrier-conjugated biologics to address poorly served CNS indications. The deployment of NRC's BBB carriers will create a global competitive advantage for Canadian SMEs developing therapeutics for targets within the CNS.

In 2015-16 NRC will:

- Enable its clients and collaborators (Canadian SMEs) to advance their innovative drug candidates to Investigational New Drug (IND) filing and clinical trials, two critical milestones in drug development.
- Foster Canadian biomanufacturing by transferring proprietary technologies and know how to Canadian contract manufacturing organizations and innovative SMEs, with the goal of creating 'made in Canada' biologics.
- Progress its brain-penetrating carriers, in collaboration with its partners, to proof-of-concept *in vivo* testing in more complex models, and to IND.

Sub-Program 1.1.9: Information and Communication Technologies

Description

In support of Canada's digital economy, this sub-program applies leading-edge expertise in software development, semiconducting materials and photonic device design and fabrication to design, validate, demonstrate and deliver both physical and software solutions that lead to new market opportunities for industries in Canada's information and communication technology (ICT) sector that seek to profit from an explosive growth of data and from escalating needs for greater connectivity and for revolutionary ways to use computers to make decisions, synthesize information, and discover new knowledge. This is important for increasing Canada's global share of the growing ICT market. Results are achieved through multi-disciplinary collaborative research and development services in addition to specialized technical services in state-of-the-art facilities for transferring or advancing technologies into deployed solutions and improved practices for the marketplace. This includes custom manufacturing of novel components for innovative photonic, electronic, and opto-electronic devices.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
32,346,442	34,210,693	35,774,502

Human Resources (FTEs)

2015–16	2016–17	2017–18
147	151	155

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancements of process and product technologies for the information and communications technology sectors	Client/stakeholder financial investment in technology development	$10M	March 2016
	Licensing and royalty revenue from NRC clients	$0.40M	March 2016

Planning Highlights

In 2015-16, NRC will continue to:

- Work with the security industry to develop software-based, multimedia analytic tools (e.g. sentiment analysis, machine translation, situational awareness, and data mining) that enable users to find information quickly and more efficiently. NRC will participate in projects to provide end-users in the security sector with

advanced tools for analyzing multilingual texts to monitor risks to Canada and public perceptions of those risks.

- Support skills development and contribute to the reduction of labour shortages through personalized training and enhanced access to learning resources. NRC will engage more industrial partners to add modules and features to platform prototypes and enable immediate access to training and professional development.
- Bring industry partners together to explore innovations that pave the way for advanced optical communication and create opportunities for growth in the Canadian communications sector. Targeted applications include next generation optical communication components to enable the Canadian photonics sector to scale-up fibre optic communication network capacity, with an emphasis on new technologies that can be deployed within five years. NRC will work to increase existing client engagement in advanced photonics development and develop partnerships with other global leaders in photonics R&D.
- Contribute to developing technologies and devices for the next generation of radio frequency power transistor technology, which offers greater power and efficiency and wider bandwidth than today's solutions. NRC will also offer semiconductor foundry services to key industry players, helping to strengthen the Canadian supply chain for Gallium Nitride electronics. NRC will upgrade its Product Design Kit and engage new industrial partners to invest in this technology.
- Perform ground-breaking research in Printable Electronics (PE). The focus will be on developing conductive inks with the industry leaders comprising the PE Consortium, while licensing technology to more companies in the ecosystem. An emerging field, PE involves several industries (e.g. ICT, materials, digital manufacturing, and printing) presenting a transformative opportunity to add intelligence to everyday objects, powering the Internet of Things. NRC's long-term goal is to position the packaging, commercial and security printing industries to be early adopters of emerging PE solutions.

Sub-Program 1.1.10: Security and Disruptive Technologies

Description

This sub-program builds and validates emerging technology platforms (such as nanotechnology, quantum technologies and the convergence of nano-, bio- and information technologies) that can be applied in a range of industries to sustain Canada's industrial competitiveness by opening new markets and value networks for Canadian industries in tomorrow's economy. Efforts focus on applications for addressing national security challenges because security and defence innovation players are amongst the earliest adopters of such technologies from which broader commercial adaptations ultimately evolve, replacing existing technologies. Results are achieved through multi-disciplinary collaborative research and development services in addition to specialized technical services in state-of-the-art facilities for ultimately introducing disruptive and transformational technology solutions into practice and the marketplace.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
19,511,329	21,051,877	21,756,793

Human Resources (FTEs)

2015–16	2016–17	2017–18
114	116	118

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Advancement of process and product technologies in security and other industry sectors	Client/stakeholder financial investment in technology development	$3.95M	March 2016
	Licensing and royalty revenue from NRC clients	$0.12M	March 2016

Planning Highlights

Meeting the immediate needs of industry also means looking longer-term at emerging technologies that will underpin the future of Canadian industry. NRC works with key collaborators in industry and in other research organizations to accelerate the development of new technologies and help clients bring innovations to market.

In 2015-16, NRC will:

- Work in collaboration with private, public sector and university partners to develop quantum photonic sensing and cyber security technologies. Quantum sensing and cyber security align NRC's photonics strength with Canada's strength

in natural resources exploration, extraction and processing, as well as capabilities in quantum information research. This work will enable the Canadian photonics industry to develop communication and measurement solutions for the security and natural resources sectors. NRC will collaborate with private, public sector and university partners to evaluate quantum photonic sensing and cyber security proof concept technologies with respect to industry needs.

- Support the development and coordination of international standards, policies and practices pertaining to nanotechnologies and contribute to large-scale international cooperative efforts to develop new and improved measurement standards and reference materials that encompass nanoscale features (see also Sub-Program 2.1.2, Measurement Science and Standards). NRC will work with researchers and entrepreneurs on nano-enabled technologies for the growth of Canadian industries. NRC will work with industry, academic and provincial organizations to enhance insights and facilitate access into global market opportunities for nanotechnologies, understand evolving industry needs and support multidisciplinary collaboration with researchers and industry.
- Continue work to be a "one-stop-shop" for nano-materials solutions for security materials technology. NRC will contribute to developing and delivering cost-effective, highly efficient, next-generation, nano-materials and armour systems, including testing and performance evaluation. Over the coming year, NRC will collaborate with Defence Research and Development Canada and industry partners to develop targeted applications focused on improving the performance-to-weight ratio for armoured vehicles and personal protective equipment.

Program 1.2: Industrial Research Assistance Program (IRAP)

Description

The program contributes to the growth and prosperity of Canadian small and medium sized enterprises (SMEs) by stimulating innovation, adoption and/or commercialization of technology-based products, services, or processes in Canada. This is done through: 1) technical and related business advice and networking facilitated by a cross-Canada network of field professional staff; 2) cost-shared merit-based contributions; and 3) contributions supporting employment of post-secondary graduates. This program uses funding from the following transfer payments: Contributions to Firms; Contributions to Organizations; Youth Employment Program (YEP); and Contributions to Canadian HIV Technology Program (CHTD), Business Innovation Access Program (BIAP) and Canada Accelerator and Incubator Program (CAIP).

Budgetary Financial Resources (dollars)

2015–16 Main Estimates	2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
293,359,644	293,359,644[1]	265,841,644	265,841,644

[1] Planned spending for 2015-16 reflect changes announced in Budget 2014, including contributions to Youth Employment Strategy ($15 million) and to Canada Accelerator and Incubator Program (an additional $40.5 million over 4 years).

Human Resources (Full-Time Equivalents [FTEs])

2015–16	2016–17	2017–18
396	410	410

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Innovative businesses grow in Canada	Small- to medium-sized enterprise jobs supported	9,000	March 2016
	Small- and medium-sized enterprises served	2,500	March 2016
	SME client feedback on growth: jobs, revenues, net operating profit	Under development[1]	

[1] Introduced in 2014-15, this indicator will be measured over a five-year interval, starting in 2015-16. While the data collection process was initiated, the amount of data received prior to the cyber intrusion was insufficient to establish a baseline. A target will be set post recovery when full complement of baseline data has been collected and analysed.

Planning Highlights

In 2015-16, NRC will assist SMEs through the provision of non-repayable funding for cost-shared innovative projects based on merit. NRC-IRAP Industrial Technology Advisors provide SMEs with technology and business advice without charge and connect them with partner organizations that can provide further assistance such as financing,

research and development, intellectual property, and technology transfer. NRC will support job creation in Canadian SMEs through the Youth Employment Program and will also enable SMEs to gain access to a Canada-wide network of technical and business expertise at universities, colleges and research institutions through the Business Innovation Access Program.

The NRC-IRAP program will increase support to innovative SMEs by working horizontally with other government departments and agencies to support the delivery of grants and contributions (i.e. Public Works and Government Services Canada-Office of Small and Medium Enterprise-Build in Canada Innovation Program (PWGSC-OSME-BCIP), Western Diversification-Western Innovation Initiative (WD-WINN), Atlantic Canada Opportunities Agency). The Concierge Service provides a single access point where innovative Canadian SMEs can access information on funding, expertise, facilities and equipment to help them grow through innovation. The new Canada Accelerator and Incubator Program (CAIP) is a five-year non-repayable contribution program aimed at establishing a critical mass of outstanding business incubators and accelerators that can develop innovative, high-growth firms, which themselves represent superior early-stage investment opportunities.

Strategic Outcome 2: R&D infrastructure for an innovative and knowledge-based economy

Program 2.1: Science Infrastructure and Measurement

Description

This program manages national science facilities and infrastructure critical to research, development and innovation by Canadian scientific and technological communities. This includes operating and administering Canada's astronomical observatories. It also fosters development and maintenance of Canada's metrological infrastructure system that provides industries and researchers access to reliable measurements that are traceable to recognized national standards maintained by the program. The program helps clients make the most of this infrastructure by facilitating access to a wide range of Canadian and international user communities and by participating in networks. In addition, the program provides stewardship of the TRIUMF sub-atomic research facility. This program uses funding from the following transfer payment: TRIUMF (Canada's National Laboratory for Particle and Nuclear Physics).

Budgetary Financial Resources (dollars)

2015–16 Main Estimates	2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
77,443,974	78,268,299	79,860,370	81,340,983

Human Resources (Full-Time Equivalents [FTEs])

2015–16	2016–17	2017–18
273	277	281

Performance Measurement

Expected Results	Performance Indicator	Targets	Date to Be Achieved
National science infrastructure and measurement standards services are valued by user communities	Client/user satisfaction	85%	March 2016

Planning Highlights

NRC manages national science infrastructure and scientific services that support Canadian excellence in R&D, as well as metrological infrastructure that underpins measurements critical to enable trade in the global economy. NRC works with academic, industrial and government partners, to ensure that national S&T facilities are managed effectively and efficiently, remaining accessible to Canadians in accordance with NRC's assigned mandate and evolving national needs. The program leverages its infrastructure

to provide Canadians access to international R&D facilities, user communities and networks.

NRC will work with partners to ensure that national S&T facilities remain at the leading edge through ongoing technology development. Canadian and international user communities will continue to have access to an array of national and international facilities to conduct their scientific research. NRC provides stewardship over facility maintenance and access as well as developing supporting tools and instrumentation, often in collaboration with industry. NRC also develops measurement standards, assisting in the responsible introduction of new technologies to the market, and allowing emerging technologies to be commercialized and enabling companies to access international markets.

TRIUMF, Canada's national laboratory for particle and nuclear physics, is owned and operated by a consortium of 19 Canadian universities. TRIUMF operations are supported by NRC, the Natural Sciences and Engineering Research Council, Natural Resources Canada, the Canada Foundation for Innovation and the Government of British Columbia. TRIUMF will continue to support the Canadian and international particle and nuclear physics community in alignment with the subatomic physics Long Range Plan, by:

- Delivering world-class science in subatomic physics and materials research through cutting-edge experiments located at TRIUMF;
- Advancing the development of the Advanced Rare IsotopE Laboratory (ARIEL) which will ensure Canada is a global leader in the production and study of rare isotopes for science, medicine and business;
- Supporting the extraction and analysis of data from international facilities, including the T2K experiment in Japan, and the ATLAS and ALPHA experiments at the European Laboratory for Particle Physics (CERN); and;
- Securing Canadian leadership in nuclear medicine and molecular imaging by advancing accelerator-based medical isotope production, including technetium-99m, and through the delivery of medical isotopes used by key partners, including the Djavad Mowafaghian Centre for Brain Health and the British Columbia Cancer Agency.

Sub-Program 2.1.1: National Science Infrastructure

Description

This sub-program manages Canada's astronomical observatories as mandated in the National Research Council Act, and it compiles and disseminates astronomical data while leveraging access to international observatories for Canadian researchers in astrophysics. This sub-program uses funding from the following transfer payment: Contributions to the International Astronomical Observatories Program.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
32,778,034	33,520,209	34,009,700

Human Resources (FTEs)

2015–16	2016–17	2017–18
114	115	116

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Canadian scientists have access to astronomical observatories and data	User access and downloads of astronomy data	4000	March 2016
	Scientific publications by telescope users	300	March 2016

Planning Highlights

In 2015-16, NRC will:

- Provide infrastructure and scientific support for radio astronomy researchers via facilities that include the Dominion Radio Astrophysical Observatory and the Atacama Large Millimeter/submillimeter Array (ALMA). NRC will maintain its role in supporting development activities related to the preconstruction phase of the Square Kilometre Array (SKA) telescope, a global project planned for construction after 2018. NRC will develop infrastructure components by improving the design and cost of production to optimize mass production of the components. NRC will participate in the development of the proposed Band 1 receivers for the ALMA telescope. The frequency range for Band 1 will enable ALMA to probe chemical differentiation in cloud cores, complex carbon chain molecules, extra-galactic radio recombination lines.

- Support the optical astronomy user community by providing infrastructure and scientific support for the Dominion Astrophysical Observatory, the Canada France Hawaii Telescope and the Gemini Observatory. NRC will operate the Canadian Astronomy Data Centre (CADC), which continues to enable advanced data processing and data mining capabilities as the astronomy community deals with increasingly large data sets.

- Design and fabricate instruments and related observatory infrastructure for operating telescopes in collaboration with industrial partners. NRC will continue to work on adaptive optic technologies that will be applicable to a range of astronomical facilities. NRC will investigate new adaptive optics components, algorithms and system concepts for next generation instruments. Related work in system controls will involve collaborative investigations of new precision opto-mechanics, segmented mirror control, integrated modeling and cryogenics. R&D efforts will continue on composite reflectors in support of next generation radio telescopes.

Sub-Program 2.1.2: Measurement Science and Standards

Description

As mandated under the National Research Council Act and also the Weights and Measures Act, this sub-program investigates and determines standards and methods of measurement for Canada's national measurement system. This national metrological system is critical for underpinning trade and commerce in the global economy. The sub-program supports international metrological treaties and arrangements to establish and maintain foreign recognition and acceptance of Canada's standards and measures that are critical for participation in multi-lateral and free-trade agreements. The sub-program provides a wide variety of calibration and measurement services that underpin the accuracy of millions of measurements conducted annually in public and private sector testing and calibration laboratories. In addition, the sub-program provides expert assessments and formal recognition of the measurement capabilities of industrial calibration laboratories. This is important for providing Canada's trading partners confidence in the reliability of Canadian industries' measurements and test certifications of compliance to regulatory and product standards that govern trade. The sub-program also develops measurement standards for emerging technologies that open new global market opportunities for Canadian industries.

Budgetary Financial Resources (dollars)

2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
25,043,259	25,866,980	26,858,102

Human Resources (FTEs)

2015–16	2016–17	2017–18
153	155	158

Performance Measurement

Expected Results	Performance Indicators	Targets	Date to Be Achieved
Internationally-recognized national system of measurement that meets Canada's evolving needs.	MSS clients served	725	March 2016
	Calibration and measurement capabilities recognized internationally	600[1]	March 2016
	Scientific and other publications in metrology	1500	March 2016

[1] The number of calibration and measurement capabilities recognized internationally during the reporting period, measured by the number of approved calibration and measurement capabilities of this Sub-Program as published in the Key Comparisons Database of the Bureau international des poids et mesures.

Planning Highlights

NRC focuses on areas of national metrological infrastructure that provide the evidence basis for standardization, reliable testing and production methodologies, as well as internationally recognized certification and accreditation schemes.

In 2015-16, NRC will:

- Support the productivity (particularly efficiency, quality, safety) of clients in target sectors (e.g. energy, health, and industrial processing) by providing metrology services that aim to ensure Canadian companies better meet supply chain requirements and are well-positioned to meet global market access requirements. NRC will also work to strengthen the national measurement system, ensuring it is capable of responding effectively to evolving national measurement needs such as effective certified reference material (CRM) distribution, addressing metrology impacts on 'factories of the future' and redefinition of the International System of Units (SI).

- Facilitate Canada's entry into global markets for new technologies by developing measurement standards for emerging areas e.g. environment and biotechnology. NRC will also develop measurement solutions (including leading the production of selected nanocellulose reference materials and documentary standards) that underpin nanoscience applications, contribute to a greater understanding of nanomaterials in the environment, and promote safe and responsible utilization of nanotechnologies (see also Sub-Program 1.1.10, Security and Disruptive Technologies). NRC will work with international peers to evaluate methods to assess the purity and other key measurements of nanomaterials.

- Provide scientific advice that improves and informs national decision-making for commerce, standards development, regulations and trade agreements. NRC will strengthen relationships with Canadian stakeholders, assimilate market insights and policy intelligence and participate in domestic and international forums.

Internal Services

Description

Internal Services are groups of related activities and resources that are administered to support the needs of programs and other corporate obligations of an organization. Internal services include only those activities and resources that apply across an organization, and not those provided to a specific program. The groups of activities are Management and Oversight Services; Communications Services; Legal Services; Human Resources Management Services; Financial Management Services; Information Management Services; Information Technology Services; Real Property Services; Materiel Services; and Acquisition Services.

Budgetary Financial Resources (dollars)

2015–16 Main Estimates	2015–16 Planned Spending	2016–17 Planned Spending	2017–18 Planned Spending
203,548,420	203,548,420	202,656,329	202,656,329

Human Resources (FTEs)

2015–16	2016–17	2017–18
964	964	964

Planning Highlights

As a result of NRC's IT infrastructure being compromised due to a cyber intrusion in summer 2014, NRC will continue migrating NRC's applications and services into the new security-enhanced technology environment in 2015-16. NRC will continue to refine security policies, procedures and tools to ensure NRC's assets are secured appropriately and in a manner that delivers client value. Working in a new environment and demonstrating integrity in secure business practices will enable NRC to be regarded as a trusted partner in effectively managing and safeguarding assets, information and people.

NRC's SAP business system will be used to support effective program and project management, including planning and performance tracking. In 2015-16, three-year reviews of R&D initiatives will take place to enhance performance and outcomes, support program management and investment decisions on continuance, adjustments or termination, and inform future R&D initiatives. NRC will build its strategic intelligence practices and processes for enhanced research and business opportunity identification and assessment. External communication efforts will increase the awareness of NRC and its business offerings in the marketplace, and supporting marketing and outreach activities with a new brand management strategy. Internal communications efforts will develop a new employer brand and enhance the employee experience. Finally, NRC will develop and implement a knowledge management strategy that will facilitate the increased research and business value of NRC's knowledge and information assets.

To ensure that NRC has talent in place to deliver on its objectives, a suite of talent management initiatives is planned for 2015-16 including the execution of a branding initiative to support recruitment efforts and the implementation of succession and talent development initiatives to prepare a pipeline of talent for key roles. NRC will support the development and engagement of its supervisor community in 2015-16 by continuing to offer a blend of learning opportunities and access to timely information through regular webinars, news updates/special reports, town halls and the launch of an interactive conversation series.

Section III: Supplementary Information

Future-Oriented Statement of Operations

The future-oriented condensed statement of operations provides a general overview of the NRC's operations. The forecast of financial information on expenses and revenues is prepared on an accrual accounting basis to strengthen accountability and to improve transparency and financial management.

Because the future-oriented condensed statement of operations is prepared on an accrual accounting basis, and the forecast and planned spending amounts presented in other sections of the Report on Plans and Priorities are prepared on an expenditure basis, amounts differ.

A more detailed future-oriented statement of operations and associated notes, including a reconciliation of the net cost of operations to the requested authorities, can be found on [v†] NRC's website.

Future-Oriented Condensed Statement of Operations
For the Year Ended March 31
(dollars)

Financial Information	2014–15 Estimated Results	2015–16 Planned Results	Difference
Total expenses	998,515,000	940,557,000	57,958,000
Total revenues	154,218,000	177,748,000	(23,530,000)
Net cost of operations	844,297,000	762,809,000	81,488,000

NRC's 2015-16 planned expenses reflect changes in planned grants and contribution expenses, salaries and benefits, an increased spending of externally generated revenue. NRC's 2014-15 estimated expenses include a one-time project expenditures of $40M relating to the implementation of the Business Continuity and Secure NRC project. NRC's focus on increasing its external revenue generating activities to strengthen its future financial sustainability has resulted in an increase in planned revenue spending of $177.8M in 2015-16 from $154.2M in 2014-15.

Supplementary Information Tables

The supplementary information tables listed in the *2015–16 Report on Plans and Priorities* can be found on [v†] NRC's website.

- Departmental Sustainable Development Strategy;
- Details on Transfer Payment Programs of $5 Million or More;
- Disclosure of Transfer Payment Programs Under $5 Million;
- Horizontal Initiatives;
- Upcoming Internal Audits and Evaluations Over the Next Three Fiscal Years;

Tax Expenditures and Evaluations

The tax system can be used to achieve public policy objectives through the application of special measures such as low tax rates, exemptions, deductions, deferrals and credits. The Department of Finance Canada publishes cost estimates and projections for these measures annually in the [[vi]†] *Tax Expenditures and Evaluations* publication. The tax measures presented in the ***Tax Expenditures and Evaluations*** publication are the responsibility of the Minister of Finance.

Section IV: Organizational Contact Information

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NRC Communications
1200 Montreal Road, Bldg. M-58
Ottawa, Ontario, Canada K1A 0R6
Phone: (613) 993-9101 or toll-free 1-877-NRC-CNRC (1-877-672-2672)
Fax: (613) 952-9907
TTY number: (613) 949-3042
E-mail: info@nrc-cnrc.gc.ca

Appendix: Definitions

appropriation: Any authority of Parliament to pay money out of the Consolidated Revenue Fund.

budgetary expenditures: Include operating and capital expenditures; transfer payments to other levels of government, organizations or individuals; and payments to Crown corporations.

Departmental Performance Report: Reports on an appropriated organization's actual accomplishments against the plans, priorities and expected results set out in the corresponding Reports on Plans and Priorities. These reports are tabled in Parliament in the fall.

full-time equivalent: Is a measure of the extent to which an employee represents a full person-year charge against a departmental budget. Full-time equivalents are calculated as a ratio of assigned hours of work to scheduled hours of work. Scheduled hours of work are set out in collective agreements.

Government of Canada outcomes: A set of 16 high-level objectives defined for the government as a whole, grouped in four spending areas: economic affairs, social affairs, international affairs and government affairs.

Management, Resources and Results Structure: A comprehensive framework that consists of an organization's inventory of programs, resources, results, performance indicators and governance information. Programs and results are depicted in their hierarchical relationship to each other and to the Strategic Outcome(s) to which they contribute. The Management, Resources and Results Structure is developed from the Program Alignment Architecture.

non-budgetary expenditures: Include net outlays and receipts related to loans, investments and advances, which change the composition of the financial assets of the Government of Canada.

performance: What an organization did with its resources to achieve its results, how well those results compare to what the organization intended to achieve and how well lessons learned have been identified.

performance indicator: A qualitative or quantitative means of measuring an output or outcome, with the intention of gauging the performance of an organization, program, policy or initiative respecting expected results.

performance reporting: The process of communicating evidence-based performance information. Performance reporting supports decision making, accountability and transparency.

planned spending: For Reports on Plans and Priorities (RPPs) and Departmental Performance Reports (DPRs), planned spending refers to those amounts that receive

Treasury Board approval by February 1. Therefore, planned spending may include amounts incremental to planned expenditures presented in the Main Estimates.

A department is expected to be aware of the authorities that it has sought and received. The determination of planned spending is a departmental responsibility, and departments must be able to defend the expenditure and accrual numbers presented in their RPPs and DPRs.

plans: The articulation of strategic choices, which provides information on how an organization intends to achieve its priorities and associated results. Generally a plan will explain the logic behind the strategies chosen and tend to focus on actions that lead up to the expected result.

priorities: Plans or projects that an organization has chosen to focus and report on during the planning period. Priorities represent the things that are most important or what must be done first to support the achievement of the desired Strategic Outcome(s).

program: A group of related resource inputs and activities that are managed to meet specific needs and to achieve intended results and that are treated as a budgetary unit.

Program Alignment Architecture: A structured inventory of an organization's programs depicting the hierarchical relationship between programs and the Strategic Outcome(s) to which they contribute.

Report on Plans and Priorities: Provides information on the plans and expected performance of appropriated organizations over a three-year period. These reports are tabled in Parliament each spring.

results: An external consequence attributed, in part, to an organization, policy, program or initiative. Results are not within the control of a single organization, policy, program or initiative; instead they are within the area of the organization's influence.

Strategic Outcome: A long-term and enduring benefit to Canadians that is linked to the organization's mandate, vision and core functions.

sunset program: A time-limited program that does not have an ongoing funding and policy authority. When the program is set to expire, a decision must be made whether to continue the program. In the case of a renewal, the decision specifies the scope, funding level and duration.

target: A measurable performance or success level that an organization, program or initiative plans to achieve within a specified time period. Targets can be either quantitative or qualitative.

whole-of-government framework: Maps the financial contributions of federal organizations receiving appropriations by aligning their Programs to a set of 16 government-wide, high-level outcome areas, grouped under four spending areas.

Endnotes

i **Justice Laws website**, http://laws-lois.justice.gc.ca/eng/acts/N-15/index.html
ii **EUREKA network**, http://www.eurekanetwork.org
iii. **Whole-of-government framework**, http://www.tbs-sct.gc.ca/ppg-cpr/frame-cadre-eng.aspx
iv. ***2015–16 Main Estimates***, http://www.tbs-sct.gc.ca/ems-sgd/esp-pbc/me-bpd-eng.asp
v **National Research Council Canada**, http://www.nrc-cnrc.gc.ca/eng/reports/2015_2016/rpp_index.html
vi. ***Tax Expenditures and Evaluations*** **publication**, http://www.fin.gc.ca/purl/taxexp-eng.asp